mm_row_transpose		
Trial 1		
size	time elapsed	ops/sec
32	0.000289	113.384
64	0.001972	132.933
128	0.015215	137.835
256	0.126743	132.372
512	0.955866	140.415
1024	7.34938	146.1
2048	58.9961	145.602
Trial 2		
32	0.000255	128.502
64	0.001976	132.664
128	0.014928	140.484
256	0.12064	139.068
512	0.92025	145.849
1024	7.5555	142.114
2048	60.0475	143.052

mm_col_transpose		
Trial 1		
size	time elapsed	ops/sec
32	0.000527	62.1784
64	0.003564	73.5533
128	0.014948	140.296
256	0.118098	142.062
512	1.04763	128.116
1024	14.7815	72.6408
2048	234.092	36.6947
Trial 2		
32	0.00053	61.8264
64	0.004138	63.3504
128	0.015161	138.325
256	0.127632	131.45
512	1.05394	127.349
1024	15.1847	70.7123
2048	237.674	36.1417

mm_morton_transpose		
Trial 1		
size	time elapsed	ops/sec
32	0.00054	60.6815
64	0.004018	65.2424
128	0.031488	66.6016
256	0.243854	68.8002
512	1.96357	68.354
1024	15.7892	68.005
2048	156.06	55.0424
Trial 2		
32	0.000985	33.267
64	0.005009	52.3346
128	0.030487	68.7884
256	0.244756	68.5467
512	1.96667	68.2462
1024	15.8427	67.7752
2048	158.225	54.2893

mm_row_standard		
Trial 1		
size	time elapsed	ops/sec
32	0.000254	129.008
64	0.001965	133.407
128	0.014505	144.581
256	0.113408	147.937
512	0.980311	136.913
1024	8.78097	122.281
2048	199.012	43.1628
Trial 2		
32	0.000281	116.612
64	0.001964	133.475
128	0.015092	138.958
256	0.128027	131.044
512	1.02449	131.009
1024	9.68009	110.923
2048	200.929	42.751

mm_col_standard		
Trial 1		
size	time elapsed	ops/sec
32	0.000514	63.751
64	0.00279	93.9584
128	0.014777	141.92
256	0.117277	143.056
512	1.01516	132.214
1024	9.17968	116.969
2048	193.694	44.3479
Trial 2		
32	0.000513	63.8752
64	0.00356	73.636
128	0.015461	135.641
256	0.114525	146.494
512	1.00611	133.402
1024	9.31513	115.269
2048	201.179	42.698

mm_morton_standard		
Trial 1		
size	time elapsed	ops/sec
32	0.000526	62.2966
64	0.006641	39.4736
128	0.03096	67.7375
256	0.245699	68.2836
512	1.99261	67.3579
1024	16.1155	66.6278
2048	168.019	51.1247
Trial 2		
32	0.001048	31.2672
64	0.007483	35.0319
128	0.030915	67.8361
256	0.252128	66.5425
512	2.0292	66.1431
1024	16.6142	64.628
2048	173.95	49.3817

mm_row_recursive

Trial 1

size	time elapsed	ops/sec
32	0.000507	64.6312
64	0.002807	93.3894
128	0.014589	143.749
256	0.115051	145.824
512	0.935426	143.483
1024	7.57883	141.677
2048	67.0039	128.2

Trial 2

32	0.000277	118.296
64	0.001928	135.967
128	0.015223	137.762
256	0.118928	141.07
512	0.973811	137.827
1024	7.77233	138.149
2048	69.6374	123.352

mm_col_recursive

Trial 1

size	time elapsed	ops/sec
32	0.000246	133.203
64	0.001905	137.608
128	0.014479	144.841
256	0.124718	134.521
512	0.930415	144.256
1024	7.65709	140.228
2048	66.0444	130.063

Trial 2

32	0.000247	132.664
64	0.002295	114.224
128	0.015364	136.498
256	0.122523	136.931
512	0.994144	135.008
1024	8.41195	127.645
2048	68.4151	125.556

mm_morton_recursive

Trial 1

size	time elapsed	ops/sec
32	0.001077	30.4253
64	0.003977	65.915
128	0.034779	60.2994
256	0.249222	67.3184
512	1.95151	68.7763
1024	15.5668	68.9763
2048	124.543	68.9716

Trial 2

32	0.000859	38.1467
64	0.004038	64.9193
128	0.032726	64.0821
256	0.258915	64.7982
512	2.04679	65.5746
1024	15.9662	67.2511
2048	127.397	67.4267

mm_row_strassen

Trial 1

size	time elapsed	ops/sec
32	0.00051	64.251
64	0.00193	135.826
128	0.013692	153.166
256	0.096768	173.376
512	0.656986	204.293
1024	4.59166	233.846
2048	32.2467	266.382

Trial 2

32	0.00051	64.251
64	0.003131	83.7253
128	0.014453	145.101
256	0.09431	177.894
512	0.679893	197.41
1024	4.69221	228.835
2048	32.8678	261.348

mm_col_strassen

Trial 1

size	time elapsed	ops/sec
32	0.000522	62.7739
64	0.003186	82.28
128	0.013564	154.612
256	0.096759	173.392
512	0.674156	199.09
1024	4.80255	223.577
2048	34.2083	251.107

Trial 2

32	0.000511	64.1252
64	0.001952	134.295
128	0.013549	154.783
256	0.09885	169.724
512	0.676073	198.525
1024	4.87663	220.181
2048	34.8486	246.493

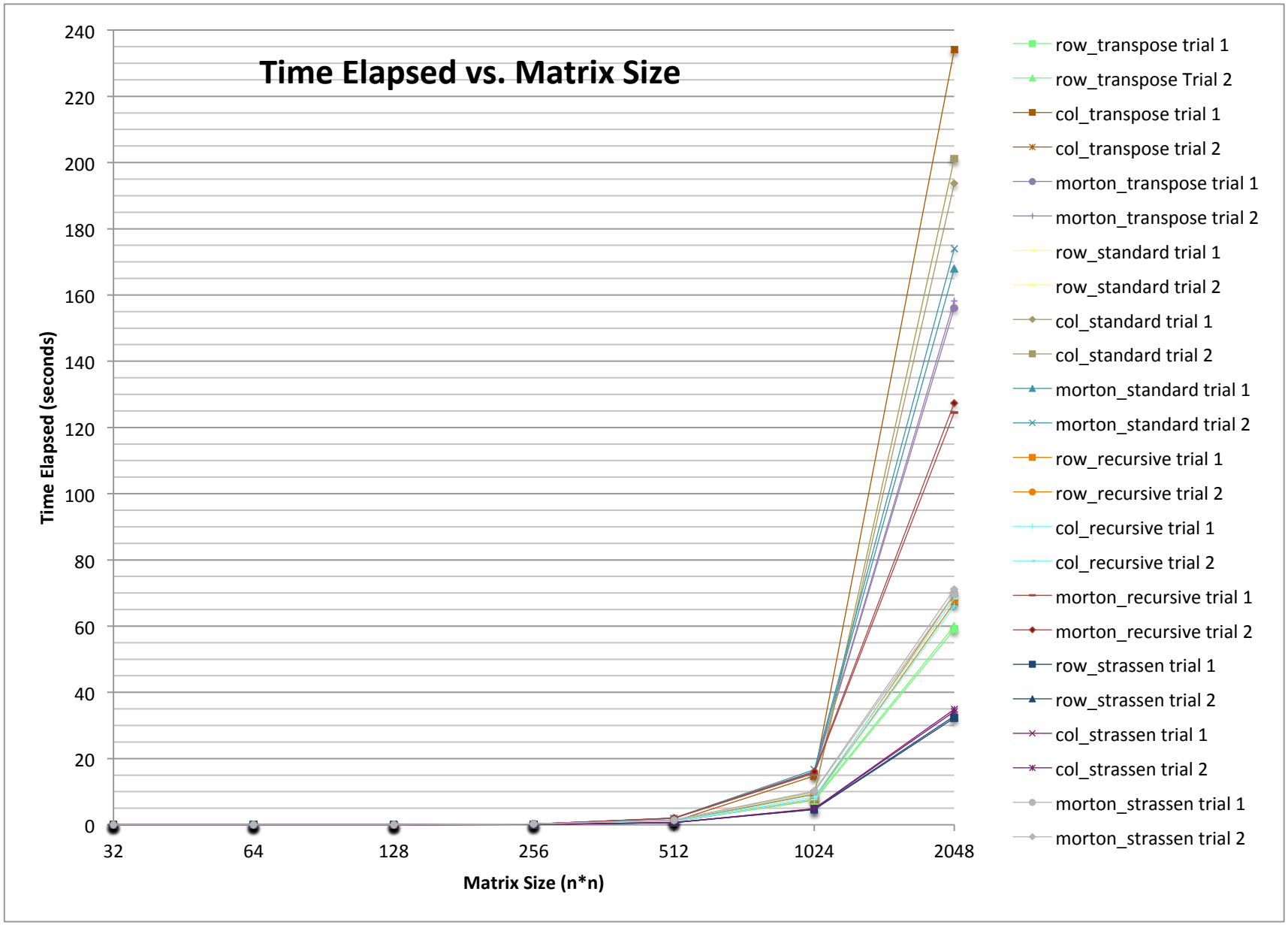
mm_morton_strassen

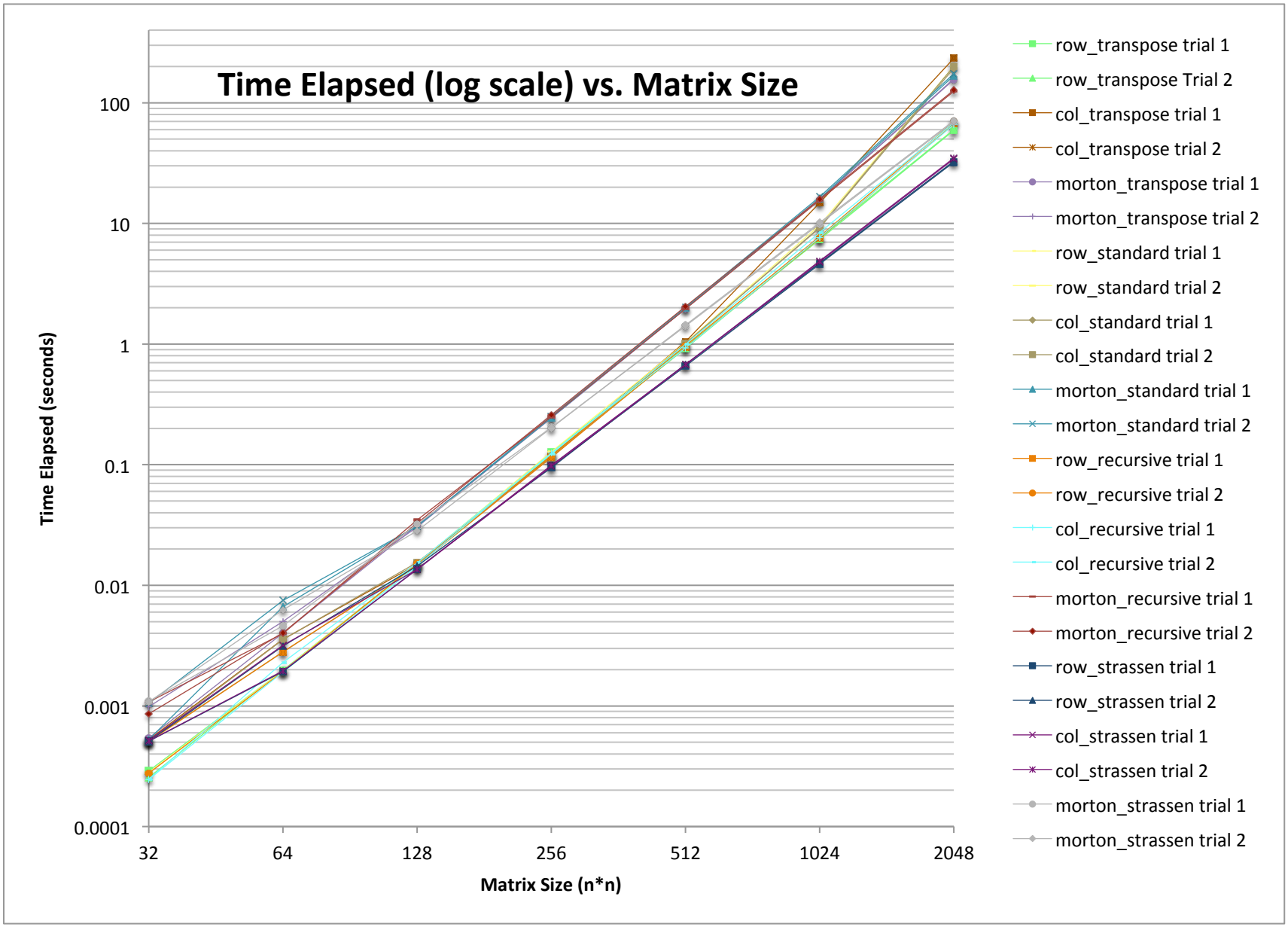
Trial 1

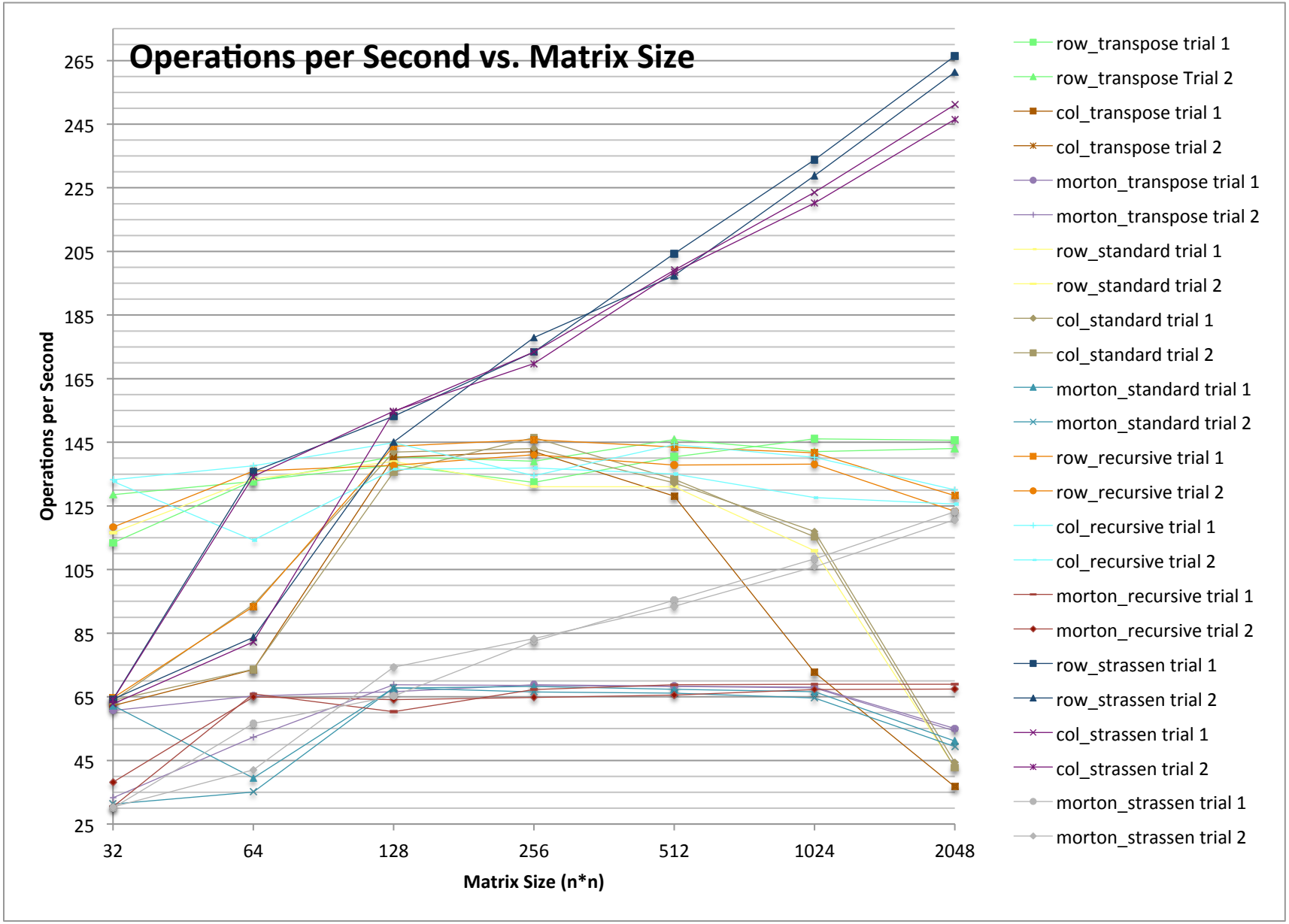
size	time elapsed	ops/sec
32	0.001089	30.09
64	0.004627	56.6553
128	0.032127	65.2769
256	0.203337	82.5094
512	1.40827	95.3067
1024	9.90812	108.37
2048	69.7272	123.194

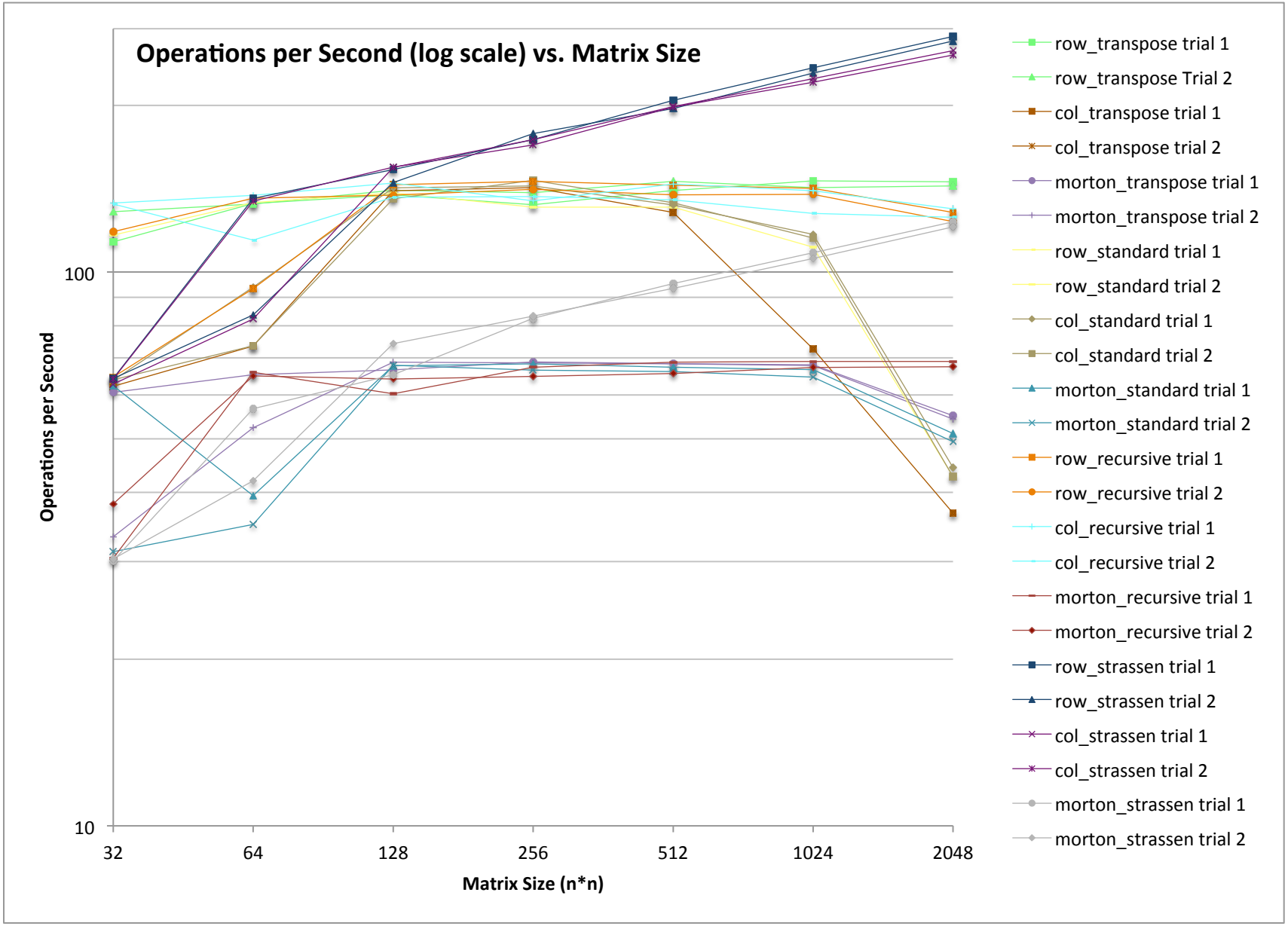
Trial 2

32	0.00108	30.3407
64	0.006242	41.9968
128	0.028222	74.3091
256	0.201406	83.3005
512	1.43664	93.4246
1024	10.1466	105.823
2048	71.1971	120.65


Time Elapsed vs. Matrix Size
Time Elapsed (seconds)
240
220
200
180
160
140
120
100
80
60
40
20
0
32
64
128
256
512
1024
2048
Matrix Size (n*n)
row_transpose trial 1
row_transpose Trial 2
col_transpose trial 1
col_transpose trial 2
morton_transpose trial 1
morton_transpose trial 2
row_standard trial 1
row_standard trial 2
col_standard trial 1
col_standard trial 2
morton_standard trial 1
morton_standard trial 2
row_recursive trial 1
row_recursive trial 2
col_recursive trial 1
col_recursive trial 2
morton_recursive trial 1
morton_recursive trial 2
row_strassen trial 1
row_strassen trial 2
col_strassen trial 1
col_strassen trial 2
morton_strassen trial 1
morton_strassen trial 2


Time Elapsed (log scale) vs. Matrix Size
Time Elapsed (seconds)
100
10
1
0.1
0.01
0.001
0.0001
32
64
128
256
512
1024
2048
Matrix Size (n*n)
row_transpose trial 1
row_transpose Trial 2
col_transpose trial 1
col_transpose trial 2
morton_transpose trial 1
morton_transpose trial 2
row_standard trial 1
row_standard trial 2
col_standard trial 1
col_standard trial 2
morton_standard trial 1
morton_standard trial 2
row_recursive trial 1
row_recursive trial 2
col_recursive trial 1
col_recursive trial 2
morton_recursive trial 1
morton_recursive trial 2
row_strassen trial 1
row_strassen trial 2
col_strassen trial 1
col_strassen trial 2
morton_strassen trial 1
morton_strassen trial 2


Operations per Second vs. Matrix Size
Operations per Second
265
245
225
205
185
165
145
125
105
85
65
45
25
32
64
128
256
512
1024
2048
Matrix Size (n*n)
row_transpose trial 1
row_transpose Trial 2
col_transpose trial 1
col_transpose trial 2
morton_transpose trial 1
morton_transpose trial 2
row_standard trial 1
row_standard trial 2
col_standard trial 1
col_standard trial 2
morton_standard trial 1
morton_standard trial 2
row_recursive trial 1
row_recursive trial 2
col_recursive trial 1
col_recursive trial 2
morton_recursive trial 1
morton_recursive trial 2
row_strassen trial 1
row_strassen trial 2
col_strassen trial 1
col_strassen trial 2
morton_strassen trial 1
morton_strassen trial 2


Operations per Second (log scale) vs. Matrix Size
Operations per Second
100
10
32
64
128
256
512
1024
2048
Matrix Size (n*n)
row_transpose trial 1
row_transpose Trial 2
col_transpose trial 1
col_transpose trial 2
morton_transpose trial 1
morton_transpose trial 2
row_standard trial 1
row_standard trial 2
col_standard trial 1
col_standard trial 2
morton_standard trial 1
morton_standard trial 2
row_recursive trial 1
row_recursive trial 2
col_recursive trial 1
col_recursive trial 2
morton_recursive trial 1
morton_recursive trial 2
row_strassen trial 1
row_strassen trial 2
col_strassen trial 1
col_strassen trial 2
morton_strassen trial 1
morton_strassen trial 2

Quintin Davis
2/17/14

1) L1: 32KB L2: 256 KB L3: 8MB
2) As caches get full, the operations per second decrease. However, the L1 cache is an exception because of it's small size, factors other than cache misses play a larger role in the overall time required.
3) From looking at the col ordered and row ordered programs, it is apparent that ordering the matrix in the same way it is read is important. Strassen multiplication of the matrices was found to be significantly faster than the other methods at large matrix sizes.